DigiVox CORPORATION

DOCKET FILE COPY ORIGINAL

ORIGINAL

February 5, 1997

RECEIVED

FEB 5 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

BY HAND DELIVERY

William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, DC 20057

Re: GN Docket No. 96-228

Dear Mr. Caton:

Enclosed is a letter from Stan Kay, Assistant Vice President Engineering, Hughes Network Systems ("Hughes") responding to the January 30, 1997 letter of Primosphere. This letter refutes the various arguments made by Primosphere. Therefore, DigiVox Corporation ("DigiVox") urges the Commission to adopt the proposal made by Hughes in its letters of January 22, 1997 and January 27, 1997 that were previously submitted to the Commission. Copies of those letters as well a letter from RC Malkemes of Bellcore and a letter from Siemens Stromberg-Carlson that were also previously submitted are enclosed.

Very truly yours,

John Prawat
President and CEO

cc: Michele Farquhar, Chief, Wireless Telecommunications Bureau
D'Wana Speight, Wireless Telecommunications Bureau
Thomas P. Stanley, Wireless Telecommunications Bureau
Nancy Markowitz, Wireless Telecommunications Bureau
Kathleen O'Brian Ham, Chief, Auctions Division
Jonathan V. Cohen, Auctions Division (on detail)
Matthew Moses, Auctions Division
Josh Roland, Auctions Division
Walter D. Strack, Policy Division, Wireless Telecommunications Bureau
Evan R. Kwerel, Office of Plans and Policy
John R. Williams, Office of Plans and Policy

No. of Copies rec'd 0+14
List ABCDE OCT

Bruce A. Franca, Office of Engineering and Technology
Tom Mooring, Office of Engineering and Technology
Steve Sharkey, International Bureau
Ronald Repasi, International Bureau
Kimberly M. Baum, International Bureau
William E. Kennard, General Counsel
Peter A. Tenhula, Office of General Counsel
Lisa M. Higginbotham, Office of General Counsel
Catherine Sandoval, Director, Office of Communications Business Opportunities
Eric Jensen, Deputy Director, Office of Communications Business Opportunities
S. Jenell Trigg, Office of Communications Business Opportunities
Jackie Chorney, Office of the Chairman
Julius Genachowski, Office of the Chairman
Rudolfo M. Baca, Office of Commissioner Quello
David R. Siddall, Office of Commissioner Ness
Suzanne Toller, Office of Commissioner Chong
David W. Zesiger, Office of Advocacy, U.S. Small Business Administration

P:\WP51DOC\EJG\85150005.LTR

ATTACHMENT 1

HUGHES
NETWORK SYSTEMS
A HUGHES ELECTRONICS COMPANY

February 5, 1997

John Prawat
President and CEO
DigiVox Corporation
P.O. box 65094
Washington, DC 20035

Dear John:

The January 30, 1997 Primosphere letter to the commission claims that the Hughes Network Systems (HNS) letters of January 22 and January 27 were "severely flawed and containing numerous glaring errors." HNS disagrees with this statement. This letter addresses each point made by Primosphere.

Primosphere repeats their earlier argument that 0.2 dB is a more reasonable choice of noise floor rise due to interference than 2 dB because there may be multiple interferers. HNS asserts that it is reasonable to ignore the unlikely case of a Primosphere receiver being very close to a handset from two different WCS providers at the same time, or near two base stations from two different providers at the same time. If the interferers are farther away, then their interference contribution will decrease dramatically and can be ignored. Furthermore, HNS repeats its request that Primosphere disclose their budget for margin for such effects as tree and building shadowing, Ricean fading, and terrestrial interference so that we can fairly assess the relative impact of WCS.

The next point of contention in the Primosphere letter is that "Digivox fails to recognize that the out of band emissions interference limits it recommends does not include a recommendation as to roll-off with frequency." We did not fail to recognize the need for this information, we excluded it because it is completely irrelevant. Since we have stated the amount of energy that will be found in the SDARS band, it should be of no concern to SDARS what the energy is in the intervening band. It will certainly be less than any service provided in that band and SDARS will need to design their receive filters based on such services, not on the WCS interference.

The next point is the Primosphere assertion that a "312 microsecond long burst every 2.5 milliseconds will break a communication link just as well as a continuous signal" may or may not be correct. If, for example, the symbol time is 2.5 milliseconds, then HNS' claim that the 312 microsecond interference burst will be averaged over the symbol is correct. Alternatively, if the system uses error correcting coding, the effects of individual symbol errors may not be that significant. For example a Golay (24,12) error correcting code can correct 3 errors in 24 bits which is the 1/8 error rate that would be introduced by the worst case WCS interferer. Such rate ½ codes are quite normal in the satellite channel. If

11717 Exploration Lane, Germantown, MD 20876
Tel: (301) 428-5500 TWX: 710-828-0541
FAX: (301) 428-1868/2830

Primosphere will disclose some additional information about their modulation, coding and link margins then a reasonable assessment of the impact of the duty cycle of the WCS interferer could be made. This was explained in our January 27 letter.

Regarding the energy absorbed by the human head, we stated in our letter that the effect would be 3-15 dB depending on the orientation. It is reasonable to include some amount of absorption for the average case.

Finally, the antenna isolation of 20 dB is called into question. For an antenna mounted at 25' and a distance of 24' to the SDARS receiver, it should be clear that the SDARS is almost directly below the WCS transmitter. For example, the transmitter might be on a support cable wire holding a traffic signal where the SDARS vehicle is waiting for the light to change. The DB910C-M antenna from Decibel Products has a vertical beam pattern which is between 20 and 25 dB down in the direction of this vehicle. As the vehicle gets closer to the antenna the gain falls off dramatically. Therefore, it is not "inconceivable that such a level of isolation could be provided given the broad beam characteristics of an omni-dipole antenna" as asserted by Primosphere.

HNS wishes to repeat its request that Primosphere provide adequate information on their design assumptions so that an analysis of the effects of WCS emissions can be made relative to the other impairments they will surely suffer.

Sincerely,

Stan Kay

Stan Kay
Assistant Vice President
Hughes Network Systems

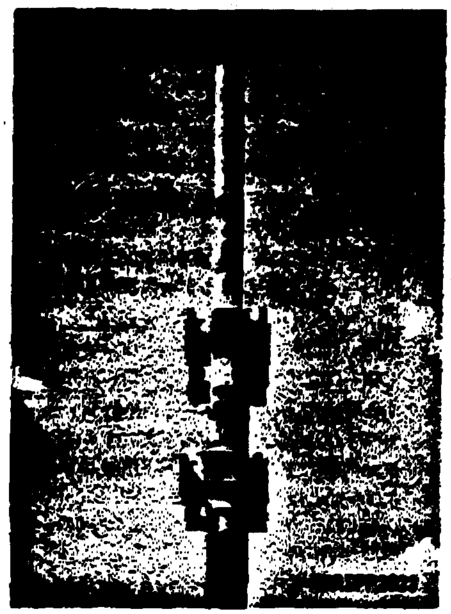
ALLEN GROUP

ASPP2933, ASPP2936 PCS OMNI ANTENNAS DB910C-M 3, 6 or 10 dBd, 1850-1990 MHz

Decibel Products and Antenna Specialists, divisions of ATG, have created a complete line of PCS antennas for 1850-1990 MHz. With aesthetically pleasing designs and very low profiles, the field-tested antennas are now available for domestic and international applications.

Three omnidirectional transmit and/or receive models are offered with 3, 6 or 10 dBd gain.

- **Sturdy Construction** - All three have radomes of tough fiberglass, two ASP models are white in color, the DB model has blue green Mirage™ fiberglass. Radiators are made of passivated aluminum or brass, hardware of galvanized or stainless steel.
- **Power Rating** - 400 watts maximum input.
- **Trouble Free** - Each antenna is tested for power rating compliance and the absence of intermodulation generators.
- **Lightning Resistant** - Direct ground.
- **Mounting** - The ASP models are shipped with two ASPA320 mounting clamps. The DB model has an integral dual purpose mount that can be top or side mounted to a pipe with V-bolts, included.



Ordering Information

N-Female	7/16 DIN Connector	Gain – dBd/dBi
ASPP2933	ASPP2933G (on 300 mm pigtail)	3/5.1
ASPP2936	ASPP2936G (on 300 mm pigtail)	6/8.1
DB910C-M	DB910CE-M	10/12.1

Electrical Data

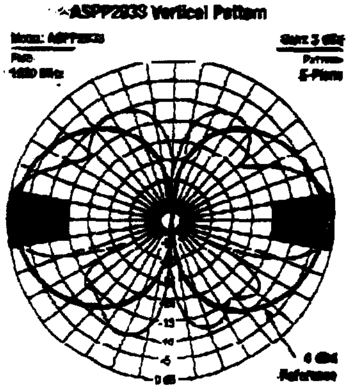
	ASPP2933	ASPP2936	DB910C-M
Frequency ranges – MHz	1850-1990	1850-1990	1850-1990
Gain – dBd/dBi	3/5.1	6/8.1	10/12.1
VSWR	< 1.5:1	< 1.5:1	< 1.5:1
Beamwidth (3 dB from maximum)	32°	12°	5°
Polarization	Vertical	Vertical	Vertical
Maximum power input – watts	400	400	400
Input impedance – ohms	50	50	50
Lightning protection	Direct ground	Direct ground	Direct ground
Termination – standard	N-Female	N-Female	N-Female
Jumper cable	Order separately	Order separately	Order separately

Mechanical Data

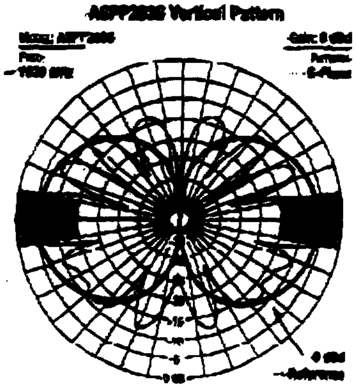
	ASPP2933	ASPP2936	DB910C-M
Overall length – in. (mm)	24 (610)	36 (915)	77 (1956)
Radome OD – in. (mm)	1.0 (25.4)	1.0 (25.4)	1.5 (38)
Wind area – ft² (m²)	.11 (.01)	.17 (.015)	.5 (.05)
Wind load at 100 mph (160 kph) – lbf (N) kp	4.4 (19.6) 2	6.8 (30.2) 3	20 (89) 8.9
Maximum wind speed – mph (kph)	165 (266)	165 (266)	125 (200)
Weight – lbs. (kg)	4 (1.8)	6 (2.7)	5.2 (2.4)
Shipping weight – lbs. (kg)	11 (4.9)	13 (5.9)	9 (4.1)
Clamps	ASPA320	ASPA320	Integral Dual Purpose

UPS SHIPPABLE

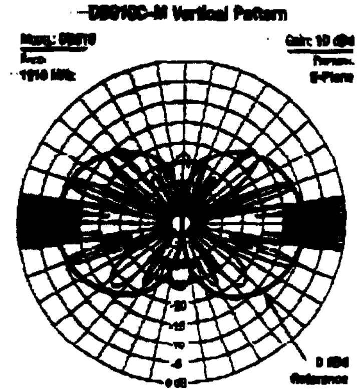
ASPP2933 Vertical Pattern



ASPP2936 Vertical Pattern



DB910C-M Vertical Pattern



ATTACHMENT 2

HUGHES
NETWORK SYSTEMS
A HUGHES ELECTRONICS COMPANY

January 22, 1997

John Prawat
President and CEO
DigiVox Corporation
P.O. box 65094
Washington, DC 20035

Dear John:

Hughes Network Systems (HNS), a business unit of General Motors Hughes Electronics, is a major supplier of cellular radio equipment and one of the driving forces behind the commercialization of the Personal Access Communications System (PACS). The Commissions Rules to Establish Part 27 offer potential bands in which PACS technology could be deployed if the interference into SDARS can be managed. The out of band emissions limits proposed by Primosphere of

Mobile Transmit	123 + 10 log (P) dB
Base Transmit	92 + 10 log (P) dB

preclude economical deployment of any present-day wireless technology. Lucent in its January 8 filing indicated that the diplexing equipment required would cost several hundred dollars, which is clearly not appropriate for a handset. HNS agrees with this assessment. Alternatively, backing off the handset power amplifier enough to give the desired linearity would require a much larger power amplifier than is practical for a handset.

Lucent, in their 13 January Supplemental Technical Statement, proposed fixed stations for both forward and reverse links. While this arrangement does provide adequate protection for SDARS, it limits the commercial appeal of the WCS bands because it eliminates mobile systems. Even in the case of Wireless Local Loop, a large part of its marketability is the concept of extended cordless service allowing the subscriber to take his phone to the park, the mall or the office.

11717 Exploration Lane, Germantown, MD 20876
Tel: (301) 428-5500 TWX: 710-828-0541
FAX: (301) 428-1868/2830

To accommodate SDARS and PACS in the WCS band, HNS proposes the following allocations.

Band	Frequency	Use
A	2305-2310	PACS Paired with E
B	2310-2315	PACS Paired with F
C	2315-2320	Fixed Voice/Data Unpaired
SDARS	2320-2345	SDARS
D	2345-2350	Fixed Voice/Data Unpaired
E	2350-2355	PACS Paired with A
F	2355-2360	PACS Paired with B

Bands C and D may use the out of band emissions recommendations offered by Lucent of

Subscriber Transmit	60 + 10 log (P) dB
Base Transmit	70 + 10 log (P) dB

and case-by-case interference mitigation as required.

With the frequency plan proposed above, Bands C and D serve as 5 MHz buffer zones between the SDARS and PACS equipment. HNS proposes that the out of band emissions in the SDARS band from the PACS equipment in bands A/E or B/F meet limits of

Mobile Transmit	70 + 10 log (P) dB
Base Transmit	70 + 10 log (P) dB

HNS proposes that the out of band emissions in the C and D bands from the PACS equipment in bands A/E or B/F meet limits of

Mobile Transmit	40 + 10 log (P) dB
Base Transmit	60 + 10 log (P) dB

It is important to note that, even with the 5 MHz buffer zone, the Primosphere suggested limits of 123 and 92 dB are not achievable in practical systems. Neither would a mobile transmit limit of 90 + 10 log(P) dB be achievable at a reasonable cost with today's technology.

The interference analysis for the reverse link is given in Table 1. It indicates that 70 dB isolation will be adequate to protect SDARS receivers from PACS handsets at a distance of 12 feet. This analysis incorporates the fact that PACS has a 12.5% duty cycle and that the handset is unlikely to be in the beam of the SDARS receive antenna. It also does not account for the fact that the PACS handset will be power controlled below 200 mw for most of its operating time.

Table 1. Proposed Reverse Direction Link Budget		
SU EIRP	- 2 dBW/1MHz	200 MW in 300 kHz (neglects power control of handsets)
SU Duty Cycle	- 9 dB	12.5% Duty Cycle. 312.5 msec pulses every 2.5 msec
Min Path Loss	-50.7 dB	12 foot separation is more realistic in vehicular traffic
SDARS Ant. Gain	3 dB	Per Primosphere filings
SDARS Beam Shape	- 6 dB	Hemispheric beam pointing up - loss of at least 6dB for typical PACS handset location in traffic
Polarization Loss	- 3 dB	Vertical to linear polarization decoupling
Total	-67.7 dBW/MHz	
Interference Allowed	137.9dBW/MHz	
Required Protection	70.2 dB	

Note that this analysis uses a noise floor of -135.6 dBW/MHz and an interference degradation of 2 dB for a protection ratio of 137.9 dBW/MHz as described in the January 8 Lucent technical statement

For the forward link, HNS agrees with pages 7-11 of the Lucent analysis with some minor comments. PACS base stations will sometimes be mounted as low as 25 feet rather than the 100 feet assumed in the Lucent analysis. This will raise the interference into SDARS by 12 dB. In these cases, the PACS base station transmit power would be limited to 4 dBW/MHz, i.e., 12dB less than used in the Lucent analysis.

Sincerely,

Stan Kay
Assistant Vice President, Engineering

ATTACHMENT 3

HUGHES
NETWORK SYSTEMS
A HUGHES ELECTRONICS COMPANY

January 27, 1997

John Prawat
President and CEO
DigiVox Corporation
P.O. box 65094
Washington, DC 20035

Dear John:

Hughes Network Systems (HNS), a business unit of General Motors Hughes Electronics, is a major supplier of cellular radio equipment and one of the driving forces behind the commercialization of the Personal Access Communications System (PACS). The Commission's Rules to Establish Part 27 offer potential bands for PACS technology if the interference into SDARS proves manageable.

In our 22 January letter to you we used the allowable interference noise energy of -137.9 dBW/MHz proposed in the 13 January Lucent Supplemental Technical Statement of Lucent Technologies Inc.. We had mistakenly assumed from Lucent's statement "After technical discussion with Primosphere Limited Partnership we agree that the WCS spectrum with SDARS in the middle of the band is unique...", to mean that Lucent and Primosphere had reached agreement on the parameters to use in the analysis.

After subsequent review, we agree with Primosphere that Lucent's assumption of 2000°K receiver noise temperature is unrealistic. On the other hand, we feel that Primosphere has failed to provide adequate justification for their claimed noise floor of 200°K. HNS is the leading manufacturer of Very Small Aperture Terminals (VSAT) and understands the noise floor behavior of satellite terminals. While 200°K is a reasonable number for VSAT and other satellite communications terminals with narrow beam antennas pointed to cold sky in C-Band and Ku-Band applications, we question its legitimacy for a 2.35 GHz, car-mounted antenna for the following reasons:

11717 Exploration Lane. Germantown, MD 20876
Tel: (301) 428-5500 TWX: 710-828-0541
FAX: (301) 428-1868/2830

1. The VSAT antenna does not pick up significant terrestrial emissions because there is minimal spurious noise generated at K_u Band and because the antenna points towards 0°K space. In contrast, the side lobes of the SDARs antenna will see a variety of terrestrial sources. The 2.35 GHz band is near the 2.4 GHz ISM band in which most microwave ovens operate. Interference may also come from harmonics of the 450 MHz band terrestrial mobile radio and UHF broadcast channels 64 and 65. In addition to potential signal emissions, the temperature of the people, buildings, trees, car ignitions, etc., in the antenna pattern will be much warmer than outer space. For this reason HNS suggests adding an ambient temperature of at least 290°K to the LNA noise temperature.

2. A C Band or K_u Band LNA uses a waveguide front end with very low loss. The SDARS receiver must reject the A, B, C, D, E and F bands. HNS estimates that this would require a filter ahead of the LNA with an insertion loss close to 2 dB. This is because the SDARS equipment receiver response must roll off before entering the neighboring WCS channels to prevent a signal from a WLL base or mobile station into the front end LNA.

3. Primosphere correctly states that the LNA Noise Figure may be 1 dB. A typical receiver noise figure, however, degrades as the signal passes through mixers, filters, etc., and for low cost design can closer to 2dB.

Based on the above, HNS estimates the effective noise floor at the receiver as follows

Thermal Noise	-168.6	dBW/MHz	
80° K LNA + 290° K Environment	26	dB	It may be worse than this when terrestrial sources are nearby
Filter Insertion Loss	2	dB	To reject bands A,B,C,D,E and F
Post LNA Contributions	1	dB	Mixer, Amplifiers, etc., following LNA
HNS "Worst Case" Scenario	-139.6	dBW/MHz	
Primosphere claim	-145.6	dBW/MHz	
Split the difference	-142.6	dBW/MHz	Used for the rest of this letter

HNS suggests a compromise noise floor between the excessively optimistic Primosphere value of -145.6 dBW/MHz and the non-optimal design configuration described by HNS resulting in -139.6 dBW/MHz. HNS believes that the FCC should require Primosphere to offer evidence that -145.6 dBW/MHz is their actual noise floor. For the remainder of this letter, HNS assumes a noise floor of -142.6 dBW/MHz.

Primosphere should also demonstrate the accuracy of their claims in two other areas, the antenna pattern and the allowable noise rise.

The antenna plays a critical role in the analysis. HNS assumes that the antenna is some sort of a flat panel antenna mounted on the roof of the vehicle. The metallic floor and the car body will prevent the antenna pattern from being omnidirectional. If the PACS handset is in a vehicle or at street level, it may not be in the main beam of the Primosphere antenna. Also, the vertical polarization of the PACS signal will interact in an unknown way at the beam edge of the circularly polarized Primosphere antenna. HNS will use 3 dB main beam antenna gain for the Primosphere antenna, but include 6 dB of side lobe loss and another 3 dB of protection for linear polarization.

Allowable noise rise normally depends on the system margins. The typical fixed K_u Band VSAT application only needs rain fade margin. For SDARS, HNS expects that the largest need for margin would be for shadowing from buildings in urban areas. Primosphere should have included margin on the order of 6-10 dB for building shadowing. For the rural case there is less building shadowing, but HNS argues that the chance of a handset being very near an SDARS receiver in the rural environment is small. Both urban and rural environments should include 3-6 dB margin for Ricean fading. In such highly variable propagation environment, HNS argues that it is unreasonable to limit the noise floor rise from WCS to 0.2 dB. Even a noise floor rise of 2 dB is very generous because the handset contribution really should be combined in a root-sum-squared (RSS) manner with the shadowing and fading variances. Using -142.6 dBW/MHz as the noise floor and allowing a 2 dB rise, means an allowable interference level of -144.9 dBW/MHz for PACS.

HNS wishes to make one other point before presenting the link budgets. Since the A/E and B/F bands are spaced 5 MHz from the SDARS band, the PACS signal energy will be in the transmitter noise floor. The design constraint is controlling the broadband noise emissions. The typical design of the transmitter is a mixer from roughly a 300 MHz IF to the 2.3 GHz transmit band followed by a power amplifier. The noise floor comes from

1. *Noise entering the final mixer stage.* A SAW filter at the final IF can reduce this noise at 5 MHz from the band edge
2. *Final mixer noise figure.* Commercially available parts provide a noise figure of 10 dB.
3. *Oscillator phase noise from the final mixer stage.* Handset compatible frequency sources (reasonably priced, small, low power) will have significant phase noise energy at 5 MHz from the carrier. Since the output of the final mixer is in the transmit band, the filter Q to achieve meaningful attenuation from 2315 and 2320 MHz is unreasonable.
4. *Gain of the power amplifier..* The final amplifier stage will amplify the noise at its input. To control this, one could use a high gain mixer to reduce the gain requirements of the final stage. These components are relatively expensive.
5. *Final amplifier noise figure.* Commercial amplifiers will have roughly a 10 dB noise figure in this band and at these powers.

Assuming an amplifier noise figure of 10 dB, a high power mixer with a -10 dBm output and a final amplifier gain of 33 dB, the noise input at the power amplifier must be -124 dBW/MHz. HNS contends that even the best known handset layout, packaging, and shielding techniques cannot do better than this due to the close proximity of the digital signal processing and the fluctuations of the power circuitry. Furthermore, HNS notes that four of the five techniques suggested by Primosphere's January *13 Ex Parte* filing are being used by HNS to suppress the broadband noise, i.e., frequency planning, spectrum shaping, filtering and cross polarization. The fifth technique, amplifier backoff, is irrelevant in suppressing broadband noise.

The above assumptions result in the link analysis given in Table 1.

Table 1. Proposed Reverse Direction Link Budget			
Handset Noise Floor	- 81.0	dBW/MHz	Broadband Noise is the limiting factor
Handset Duty Cycle	- 9.0	dB	12.5% Duty Cycle. 312.5 msec pulses every 2.5 msec
Min Path Loss	-51.0	dB	12 foot separation is more realistic in vehicular traffic
SDARS Ant. Gain	3.0	dB	Per Primosphere filings
Head Loss	-5.0	dB	3 to 15 dB typical for energy absorbed by human head
SDARS Beam Shape	- 6.0	dB	Hemispheric beam pointing up gives loss of at least 6dB for typical PACS handset location in traffic
Polarization Loss	- 3.0	dB	Circular to linear polarization decoupling
Total	-152.0	dBW/MHz	
Interference Allowed	-144.9	dBW/MHz	
Margin	7.1	dB	PACS provides more than the needed margin

For the forward link, PACS base stations will be mounted as low as 25 feet or as high as 100 feet. At the 25 foot height, the base station transmitter will be limited to 800 mw which is 6 dB more power than the handset. The additional gain required in the final amplifier stages will raise the noise floor by 6 dB. Table 2 shows that these assumptions provide 1.1 dB of margin in the forward direction. For base stations mounted higher, it will be possible to raise the power in accordance with the additional path loss afforded by the greater distance.

Table 2. Proposed Forward Direction Link Budget			
Base station Noise Floor	- 75.0	dBW/MHz	Broadband Noise is the limiting factor
Min Path Loss	-57.0	dB	24 foot separation for handset directly under base station
Base antenna Gain	6	dB	Omnidirectional stacked dipole
Directivity below base station	-20	dB	Dipole has very low gain below and above antenna
SDARS Ant. Gain	3.0	dB	Per Primosphere filings
Polarization Loss	- 3.0	dB	Circular to linear polarization decoupling
Total	-146.0	dBW/MHz	
Interference Allowed	-144.9	dBW/MHz	
Margin	1.1	dB	PACS provides more than the needed margin

HNS could evaluate other for the handset being in the antenna main lobe. The typical vertical beamwidth for a 6 dBd antenna is 10-20°. For the handset to be in the main beam it will be far enough from the base station so as not to pose a problem.

Sincerely,

Stan Kay

Stan Kay
Assistant Vice President
Hughes Network Systems

ATTACHMENT 4

Bellcore

Bell Communications Research

331 Newman Springs Road
Red Bank, New Jersey 07701-5699
908-758-2000

Response to FCC Rule Making for Wireless Communication Service ("WCS")

From: RC Malkemes
Bellcore
331 Newmans Spring Rd.
Redbank, NJ, 07701
908-758-3357

Date: January 24, 1997

Sirs;

Bellcore has been a pioneer and one of the driving forces behind the commercialization and standardization of PACS, and it's predecessor, WACS, for nearly 10 years. Bellcore supports and encourages the use of PACS in the WCS band and is in agreement with the Hughes Network Systems proposal submitted at this same time. This arrangement will allow the deployment of mobile WCS PACS devices in the 2305 to 2315 and 2350 to 2360 MHz bands while allowing WCS fixed voice and data devices in the 2315 to 2320 and 2345 to 2350 MHz bands. Further, this proposal allows the use of realistically affordable technology which is currently available for filtering and signal shaping techniques.

Other comments by Lucent Technologies, dated January 13, 1997, describe analysis based upon higher output base station equipment and do not specify a modulation technique, however this analysis also points out that the levels suggested by Primosphere are somewhat conservative, with which Bellcore agrees.

As stated in Primosphere's Technical Statement of January 13, 1997, page 3, PACS utilizes Raised Root Cosine shaping to reduce the modulation spectrum. The modulation waveform may further be rolled off by additional baseband filtering or IF type narrow band filtering when upconverting the waveform before final transmission. Because PACS uses $\pi/4$ Shifted QPSK modulation, linearity constraints require fairly linear RF power amplification be used. Therefore, the RF power amplifiers are "backed off" from the 1-dB compression point to prevent spectral regrowth as suggested by Primospere.

The path loss at 2330 MHz associated with a 12 ft. distance from mobile to SDARS station is calculated using;

$$P_L = 10\mathrm{Log}\,(\lambda^2/(4\pi\ D)^2)$$

The calculated, free space path loss is 51 dB. Antenna directivity, head loss and polarization effects could cumulatively add another 10 dB to the total path loss figure. Therefore, in the 12 ft. mobile to SDARS station case, up to 61 dB of loss may be encountered by RF power amplifier wideband output noise and any other signal leaving the mobile unit before entering the SDARS reciever.

Compliance with the levels suggested Hughes Network Systems, therefore, are a matter of individual manufactures architectures and incremental cost tradeoffs. This proposal, in worse case scenarios, offers a reasonable set of solutions for both WCS users and SDARS providers.

Sincerely yours,

R.C. Malkemes

RC Malkemes
Director Radio Techniques and Technology

cc:
H W Sherry

ATTACHMENT 5

SIEMENS
Stromberg-Carlson

January 27, 1997

Mr. John Prawat, President & CEO
DigiVox Corporation
1250 24th Street N.W., Suite 350
Washington, DC 20037

Dear John,

Siemens Stromberg-Carlson, a market leader in the promotion and deployment of PACS technology, supports the proposal submitted by Hughes Network Systems to allow PACS to be used in the WCS band.

This proposal would allocate 20 MHz of spectrum (2305 to 2315 MHz and 2350 to 2360 MHz) for PACS mobility service and 10 MHz of spectrum (2315 to 2320 MHz and 2345 to 2350 MHz) for fixed voice and data services.

We believe that the proposal of HNS, with the 5 MHz buffer zone on each side of the SDARS band, will allow for PACS to be used in the WCS band without interfering with SDARS operation.

If you have any questions, please do not hesitate to call me at (561) 955-8001.

Sincerely,

John Tebes
Director PACS Edge
Wireless Business Unit

JT/mem